Mortality Update for the Pantex Weapons Facility

Jenneh Shannen Burphy, MPH
Sharon Silver, MS
Shannon Hiratzka, MPH
Mary Schubauer-Berigan, PhD
Kathy Waters, BS

Health-Related Energy Research Branch
Division of Surveillance, Hazard Evaluations and Field Studies
National Institute for Occupational Safety and Health

APHA 132nd Annual Meeting and Exposition
November 8, 2004

NIOSH

CDC WORKPLACE SAFETY AND HEALTH

Background

Pantex

- A Department of Energy plant located near Amarillo, Texas
- Originated in 1942 as an ammunitions (shells and bombs) loading plant for the U.S. Army
- Nuclear weapons fabrication facility since 1951
    - 14 square miles of land
    - Currently has over 3,000 employees

Background

The facility's primary functions include:

- Producing new nuclear weapons
- Maintaining, testing, and disassembling existing nuclear weapons
- Assembling conventional high explosives
- Related-research and development


332-11

Background

Potential exposures include:

- Low-level external radiation from nuclear weapons components
- Chemicals from high-explosives processing

Study Rationale

Mortality study by Acquavella, et al (1985) of white male workers (N=3,564) ever employed at Pantex between 1951-1978 reported:

- Strong healthy worker effect overall
- Non-significant elevations for
  - Leukemia (SMR=1.28, 95% CI=0.35-3.27, 4 deaths)
  - Brain cancer (SMR=1.36, 95% CI=0.37-3.47, 5 deaths)

Study Rationale

- Update the cohort's mortality experience by extending vital status follow-up through December 31, 1995.

- Examine mortality trends with increasing duration of employment

Study Population

4,668 workers of both genders and all races ever employed at Pantex between 1951 and 1978. This "full cohort" is divided into two sub-cohorts:

- Early-term sub-cohort (N=2,721)
  - Workers who died or terminated employment by December 31, 1978
  - Workers with complete employment records
- Late-term sub-cohort (N=1,947)
  - Workers still employed after December 31, 1978
  - Workers with incomplete employment records

Study Methods

- Records were not available to estimate historical workplace exposures.
  - Duration of employment was used as a non-specific measure of cumulative workplace exposures.
- Diseases of interest identified from the Agency for Toxic Substances and Diseases Registry (ATSDR) site summary report include:
  - Leukemia
  - Cancers of the lung, bone, prostate, brain, and thyroid
  - All cancers combined

Study Methods

- Vital Status
  - U.S. Social Security Administration (SSA)
  - National Death Index (NDI)
- Cause of Death
  - Death Certificates
  - Coded according to the ICD revision at the time of each death

Study Methods

Standardized Mortality Ratios (SMRs)

- Compared to U.S. population, 1940-1999
- External comparison
- Full cohort
- Adjusted for age, race, sex and calendar year

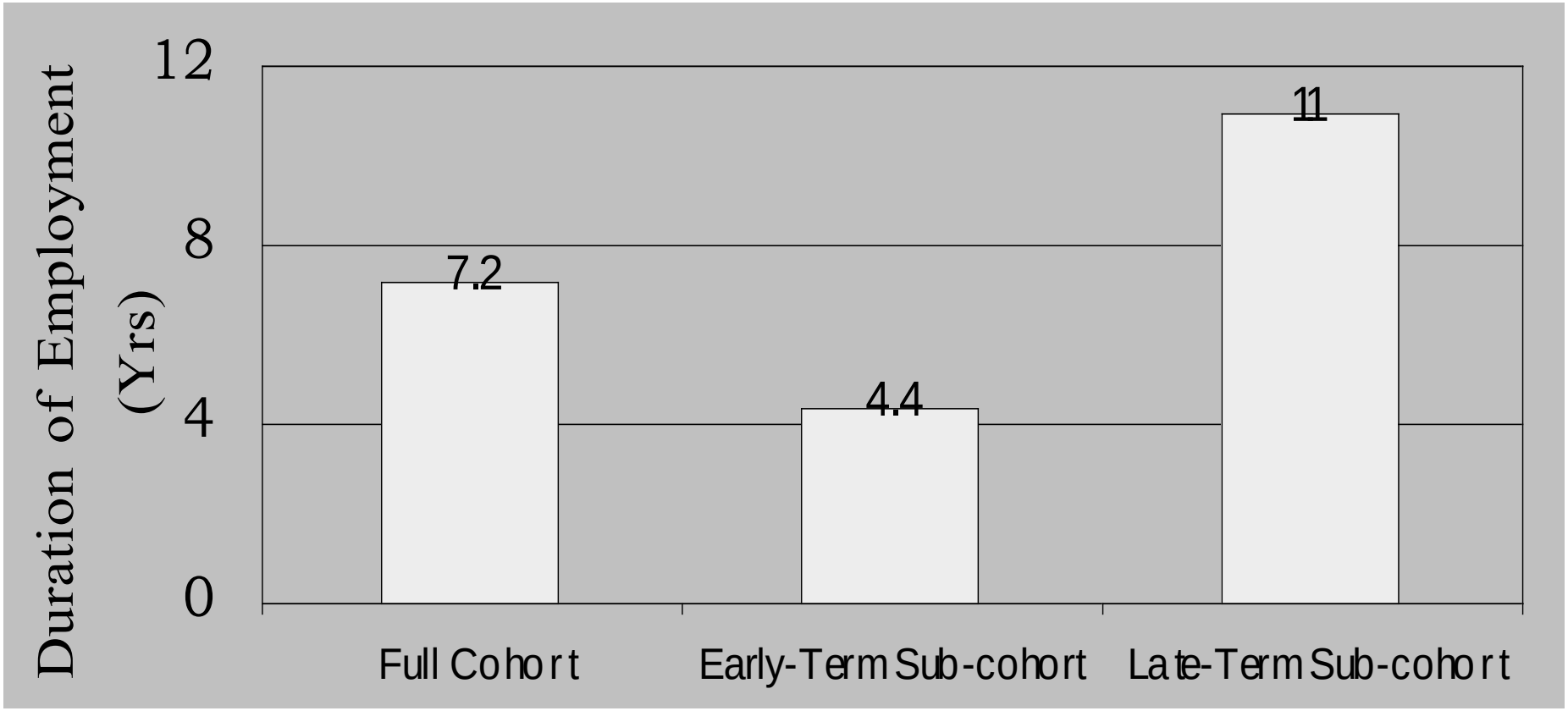
Standardized Rate Ratios (SRRs)

- Compares mortality risks from specific diseases with length of employment
- Internal comparison
- Early-term sub-cohort
- Adjusted for age, race, sex and calendar year

Descriptive Statistics

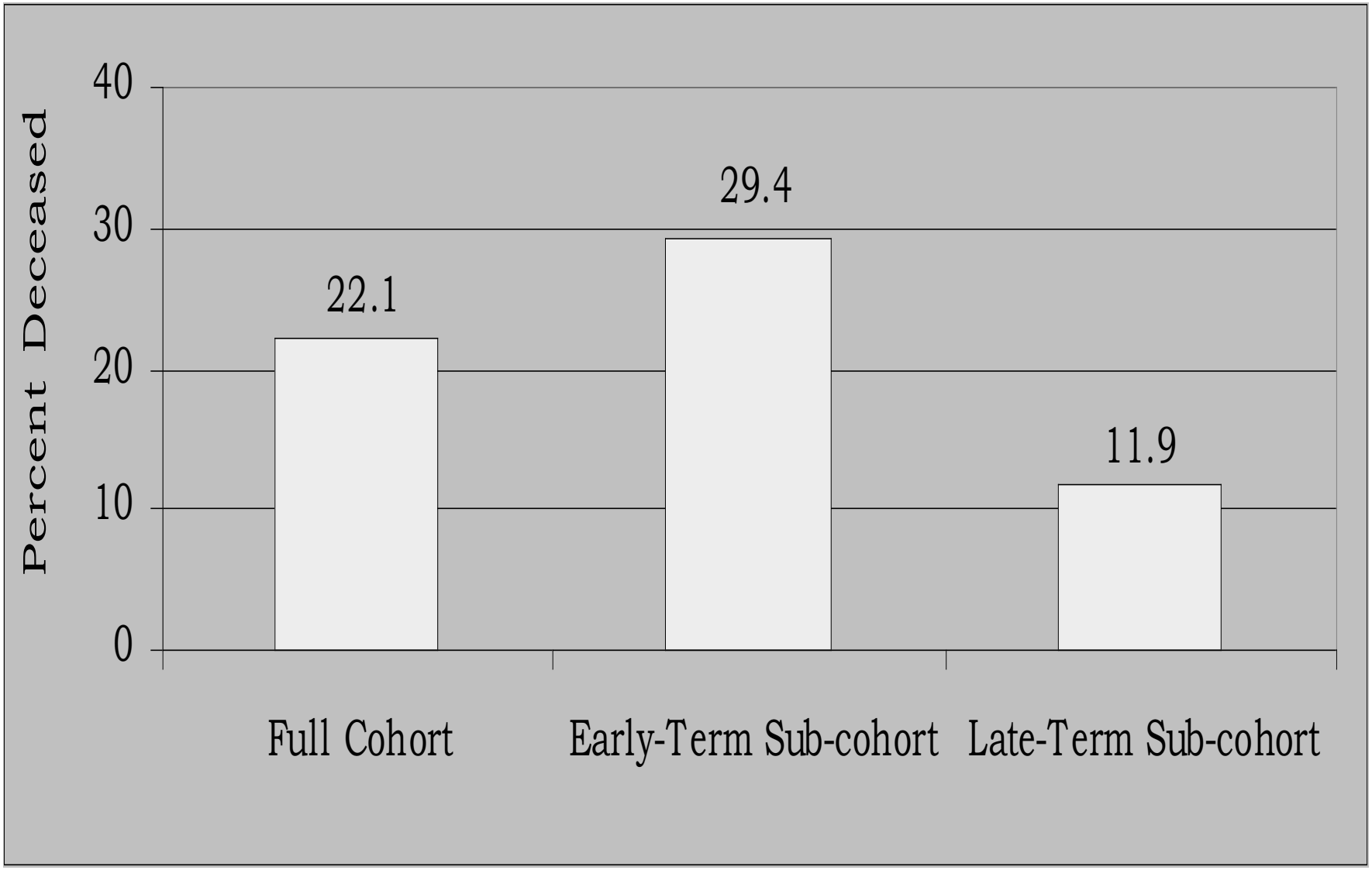
Demographics	**Full Cohort**	**Early-Term Sub-cohort**	**Late-Term Sub-cohort**
Race	95% white	97.2% white	92% white
Gender	76% male	76.3% male	75.6% male
Mean Attained Age	60.0	60.7	59.0
Mean Age at Hire	31.2	30.7	31.8

Mean Duration of Employment



Duration of employment = hire date to termination date for the early-term sub-cohort or hire date to 12/31/1978 for the late term sub-cohort. Thus, mean duration of employment for the late-term sub-cohort is greatly underestimated.

Vital Status

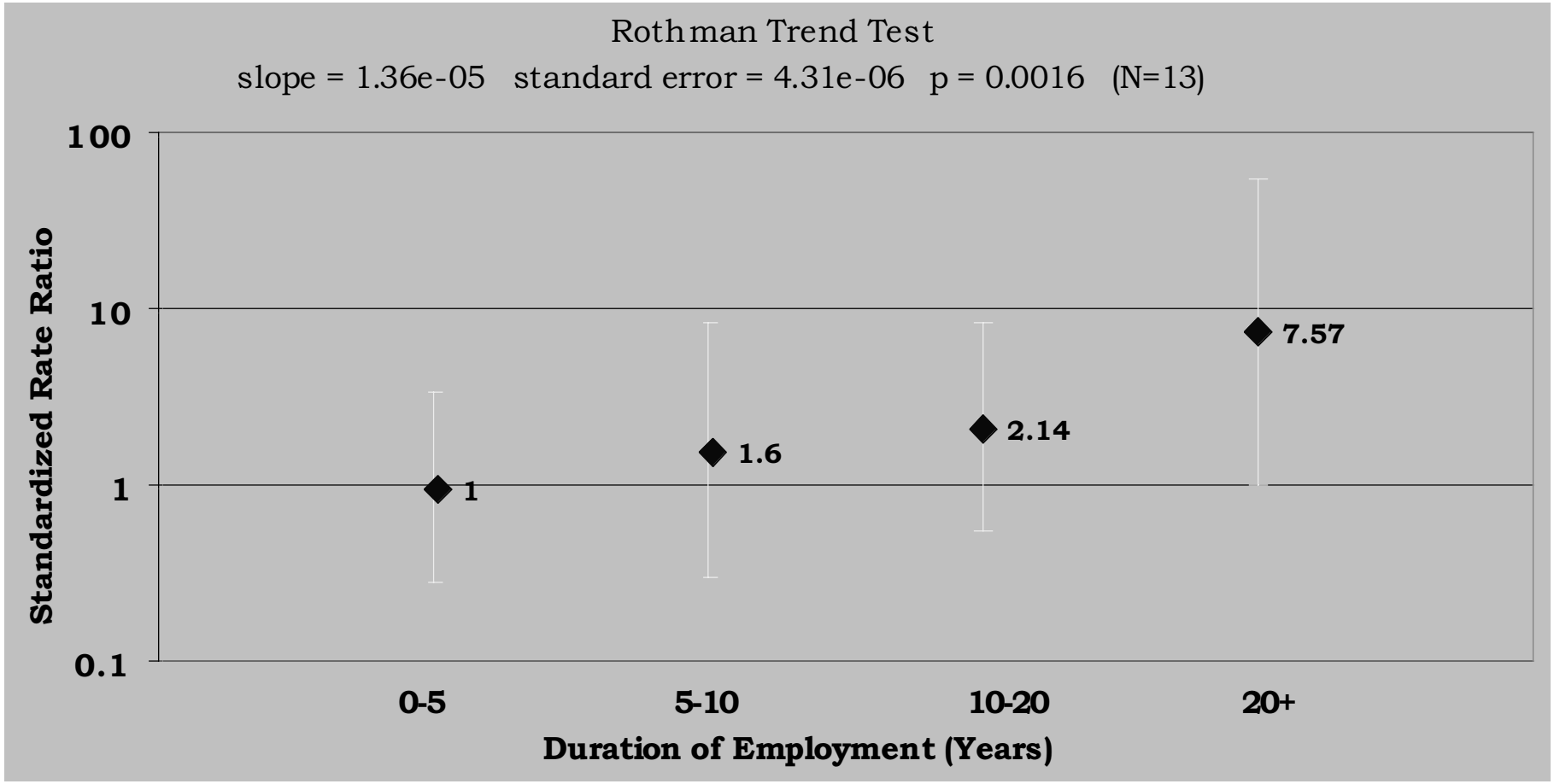


SMR Results

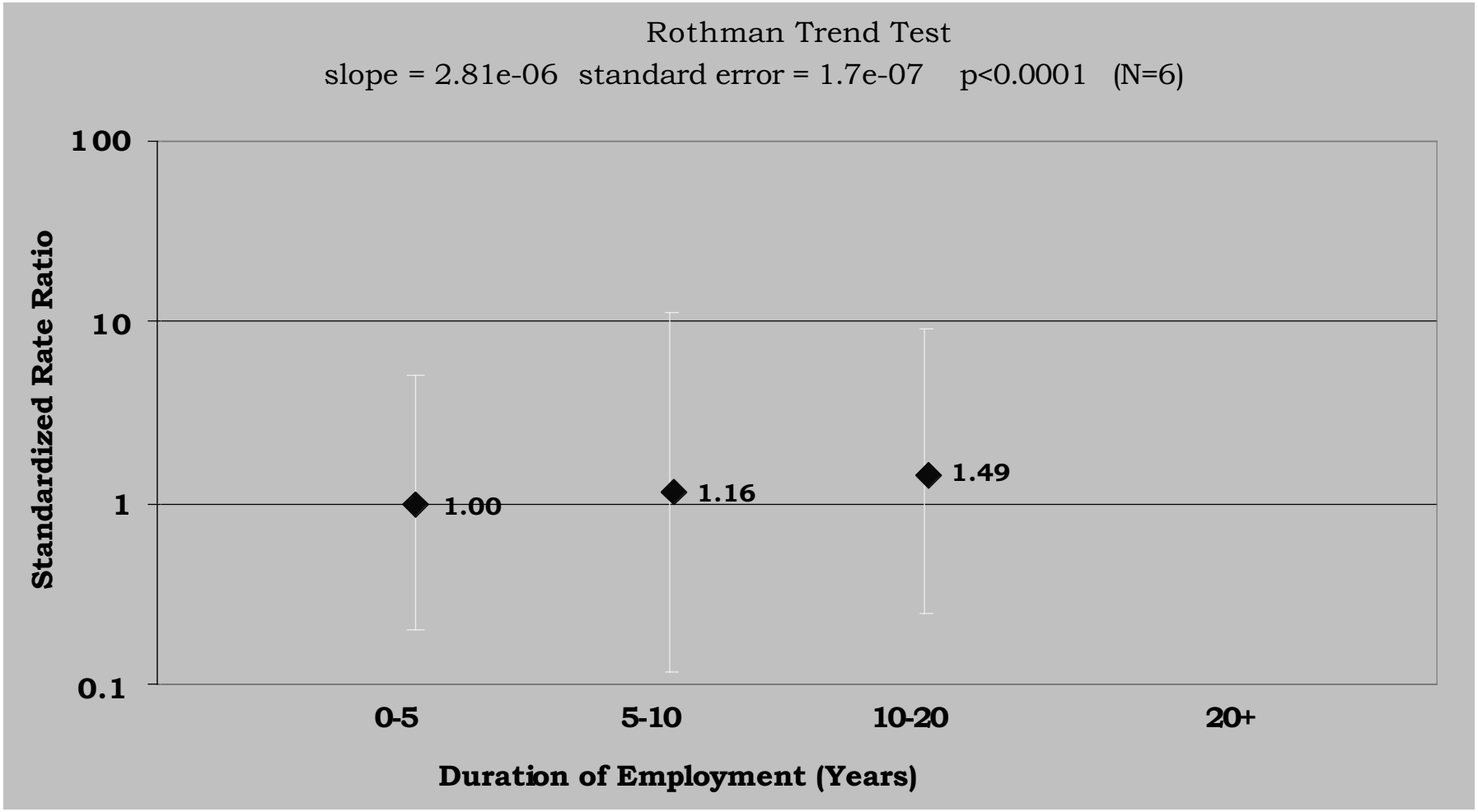
	SMR (95% CI), N	
Cause of Death	**Full Cohort**	**Early-Term Sub-cohort**
All causes	0.81 (0.76-0.86)**, 1031	0.98 (0.92-1.05), 800
All cancers	0.78 (0.69-0.88)**, 258	0.86 (0.74-1.00), 178
Leukemia	1.09 (0.58-1.87), 13	1.47 (0.73-2.63), 11
Brain Cancer (10-yr lag)	0.51 (0.17-1.19), 5	0.67 (0.18-1.71), 4
Multiple Myeloma (10-yr lag)	1.73 (0.75-3.41), 8	2.09 (0.76-4.78), 6
Prostate Cancer (10-yr lag, white males)	1.05 (0.64-1.62), 20	1.03 (0.55-1.79), 13

**p<0.01

Prostate Cancer by Duration of Employment (10 year lag, white males)



Multiple Myeloma by Duration of Employment (10 year lag)



Early-term Sub-cohort

- Mean duration of employment is 4.4 vs. 11 in the late-term sub-cohort

- Excludes long-term workers that were healthy enough to continue employment beyond the study's end date (12/31/78)

Early-term Sub-cohort

Selection bias from exclusion of long-term workers:

- _ Healthy worker survivor effect
  - A selection process whereby over time unhealthy workers are selectively removed from the workforce while healthy workers are retained in the workforce (Carpenter, 1990).
- Leads to positive bias in the SMR and SRR results
- Limits generalizability to all workers in the full cohort

Full Cohort

However, the elevated risk estimates (SMRs) for prostate cancer and multiple myeloma observed in the full cohort:

- Not likely due to this selection bias
- Suggest the need to explore whether such risk estimates are due to specific occupational risk factors

Conclusions

Further research using exposure data and complete employment history would:

- Enable assessment of the impact of specific occupational risk factors
- Facilitate duration of employment evaluation of the full cohort
- Enhance assessment of the positive trends for prostate cancer and multiple myeloma